

Cognitive Behavioral Mobile Applications: Clinical Studies, Marketplace Overview, and Research Agenda

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Objective: To review the current literature for evidence regarding the feasibility and efficacy of smartphone-based cognitive-behavioral intervention mobile applications, compare such to the number of applications on the commercial marketplaces, and explore potential steps forward for research in the field.

Methods: A literature search was conducted for papers published before February 2015 featuring quantitative results on clinical outcomes regarding the use of a smartphone for cognitive behavioral therapy, dialectical behavioral therapy, behavioral activation, and acceptance and commitment therapy. A search for the number of related applications available to consumers on the Apple and Google Play commercial marketplaces was also conducted.

Results: Nine studies, described in 11 articles, were identified that featured the use of smartphones in cognitive-behavioral interventions. The majority of studies presented pilot results suggesting the potential feasibility/efficacy of such apps. Four hundred and forty-seven related applications were found to be available on the commercial marketplaces.

Conclusions: The research base for smartphone-based cognitive-behavioral intervention mobile applications is preliminary at this point although results are encouraging. There is a discrepancy between the published literature and commercial applications available to consumers. We suggest potential steps forward in research to advance clinical use and research on this topic.

INCREASINGLY, digital technologies are gaining attention as a means to improve access to care and deliver effective therapeutic interventions directly to patients (Comer, 2015; Jones et al., 2015; Kazdin, 2015; Luxton, Mccann, Bush, Mishkind, & Reger, 2011). While computer-based therapies have been extensively studied, and overall have been shown effective (Cartreine, Ahern, & Locke, 2010), less is known about smartphone or tablet mobile applications as a tool to deliver evidence-based mental health care (Boudreaux et al., 2014; Donker et al., 2013). Smartphone applications offer a novel tool that individuals seeking mental health care now increasingly own and are ready and interested in using for their mental health (Torous et al., 2014). There are many different types and categories of mental health apps and a useful framework is to consider those that seek to help diagnosis and monitor (e.g., symptom trackers, surveys) versus those that seek to intervene and assist (e.g., self-help tools, medication reminders, guided therapy). Within either category, apps can have an adjunctive role

in clinical care or can also offer stand-alone services without the support and guidance of a clinician. Thus, there are a variety of types and uses of mental health apps that are both promising and warrant careful study.

The potential for mobile behavioral health to deliver and increase access to evidence-based therapies comes at a time of tremendous unmet needs. Anxiety and mood disorders remain the two most prevalent psychiatric illnesses, together impacting billions of people worldwide. Whether their burden is measured in patient suffering, disability, increased mortality, lost productivity, or health care costs, the impact is devastating. Although effective treatments exist for both anxiety and mood disorders, limited access to care remains a significant barrier worldwide (Kazdin & Blasé, 2011; Ustün, 1999). But while there is increasing appreciation of the potential of smartphone applications to deliver care and fill this unmet need, research and clinical experience are still in a nascent stage (Boudreaux et al., 2014; Jones et al., 2015; Powell, Landman, & Bates, 2014). In addition to limited research, other important concerns include privacy and confidentiality of data gathered with cognitive-behavioral intervention mobile applications (CBAs). Emerging research on depression is exploring apps that correlate mood symptoms with GPS location data, revealing a tremendous

Keywords: CBT; smartphone; technology; mobile

Table 1
Summary of published research on CBAs

Author	Problem area / Interventions	Sample and Study Groups	Research Design	App Time / Frequency of Use	Level of Provider Involvement	Acceptability/ Program Usage	Primary outcomes (measurement scales/tools) and within condition effect sizes ^a
<i>Behavioral Activation</i>							
Ly, Truschel, et al., 2014	Depression, Psychoeducation, activity scheduling, monitoring tool	Depressed sample with BA $n = 40$ Mindful $n = 41$	RCT (BA vs. Mindful app)	8 week / User-initiated	Maximum of 20 minutes per week therapist contact and therapist could send text messages to users	63% adhered to using the BA app all 8 weeks.	No difference between BA vs. Mindfulness. BA improved on depression: pre to post $d = 1.63$ (PHQ-9) and $d = 1.83$ (BDI-II); pre to 6 month follow up $d = 1.14$ (PHQ-9) and $d = 1.19$ (BDI-II).
<i>Cognitive Behavioral Therapy</i>							
Watts et al., 2013	Depression / CBT self-help sessions and homework	Depressed sample with CBT app $n = 15$ cCBT $n = 20$	RCT (CBT app vs. cCBT)	8 week / Six user initiated	Email and phone calls from clinicians for first 1/3 of CBT lessons	69% completed all six app lessons (across conditions). 54% very satisfied with app and 64% very confident to recommend to friend	No difference in depression (PHQ-9) between CBT app and cCBT. CBT app improved on depression (PHQ-9): pre to post $d = 1.41$.
Morris et al., 2010	Emotional self-awareness / Self-reflection and coping skills	8 with high self-rating of stress	Non-randomized	4 week / EMI multiple times daily + user initiated	Weekly meetings with a clinical psychologist.	5 case studies of using the app to increase self-awareness and cope with stress	Feasibility/Acceptability (satisfaction, feature use, and self-reported data on emotional states)
Dagoo et al., 2014	Social Anxiety / Cognitive interventions, exposure, maintenance	SAD sample with CBT app $n = 27$ IPT app $n = 25$	RCT (CBT vs. IPT app)	9 week / User initiated sessions	Weekly therapist check In	63% completed all modules of the CBT app.	Greater pre to post improvements on social anxiety (LSAS) with ACT app vs. IPT app. CBT app improved on social anxiety (LSAS): pre to post $d = .99$, pre to 3 month follow up $d = .93$.
<i>Dialectical Behavior Therapy</i>							
Rizvi et al., 2011	BPD and comorbid SUD / Opposite Action Skill	22 subjects with BPD and SUD in DBT treatment	Non-randomized	10-14 days / User initiated	None, but participants were in DBT outpatient therapy	85% adherence rate with daily assessments. 97% of skill coaching	Reductions at end of each coaching session on emotional intensity (0-10 scale) ($d = .52$ at end of

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